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2

Arthritis: Changes in Its Prevalence during the Nineteenth and Twentieth Centuries

Paula Canavese and Robert W. Fogel

2.1 Introduction

In this chapter we analyze the prevalence of arthritis and its progress over the lifecycle among Union Army veterans. We also compare patterns in arthritis among Union Army veterans with those among adult white males during the last quarter of the twentieth century.

The disease and its symptoms are described in section 2.2. Section 2.3 describes the data used to calculate the prevalence rates, and the results of our calculations are shown in section 2.4. Section 2.5 discusses factors that could affect the probability of having arthritis and the time survived with this disease. Section 2.6 summarizes our conclusions.

2.2 A Brief History of the Classifications and Treatment of Arthritis

Arthritis[1] is defined as a deforming disease of the joints, regarded by most authorities as distinct from gout and rheumatism,[2] and characterized

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1. From the Greek *arthron*, meaning "joint."

2. The terms *rheumatism* and *rheumatic diseases* are still sometimes used to describe a range of different conditions that affect the muscles, tendons, and other nonjoint tissues of the body.

by destructive changes in the cartilage and bone and by bony outgrowths restricting the motion of the joint.

The first written reference to arthritis was in 123 AD in a text from India called *Caraka Samhita,* which describes a disease where swollen, painful joints initially occur in the hands and feet, then spread to the body, causing loss of appetite, and occasionally fever (Underwood 2000).

In thirteenth century Europe any joint ailment was called *gutta*[3] for a noxious humor falling drop by drop into the joint. Gout and gouty diathesis were used as broadly as the term arthritis is used today (Kiple 1993).

Physicians such as Sydenham (1633), Musgrave (1763), Haller (1764), and de Sauvages (1768) alluded to the characteristic changes in the bone due to arthritis deformans, but the first correct description was read by Landre Beauvais before the Paris Academy of Medicine in 1800, under the name "Goute Asthenique Primitive." William Heberden, Sr. (1710–1801) of England was, however, the first to recognize its true clinical position as a condition distinct from gout. John Haygarth's 1805 paper, "Nodosity of the Joints," describes the disease clinically, and he remarked upon the peculiar incidence of its occurrence among women (Kiple 1993).

In 1891, Arbuthnot Lane attached much importance to mechanical wear and tear in the production of lesions. In 1897, James Stewart of Montreal read a paper supporting an infectious origin of the disease before the Section of Medicine of the British Medical Association. In 1951 Guillaume de Baillou, a French physician and dean of the University of Paris medical faculty, wrote one of the first books on arthritis, using the term *rheumatism* to describe a condition characterized by inflammation, soreness, stiffness in the muscles, and pain in and around the joints (Underwood 2000).

In 1680 doctors began treating rheumatism with a Peruvian bark that contains the antimalarial agent quinine. In 1763, another weapon was found to fight rheumatism: willow bark, which contains salicylate, the active ingredient in aspirin.[4] Still another drug emerged in 1929 when periodic injections of gold salts were first used to relieve muscle pain (Underwood 2000).

The first autoimmune theory of arthritis was introduced in 1939. Sir McFarlane Burnet, head of the Research Institute of Melbourne, Australia, found that autoimmunity, the process by which the body's defense system malfunctions and attacks its own tissues, causes many arthritic conditions.

The development of x-rays in 1895, the surgical pin[5] in 1907, and the ball and cup artificial hip joint in 1931 led to the formation of the American Academy of Orthopedic Surgeons in 1933 (Underwood 2000).

It was not until 1859 that rheumatoid arthritis gained its own classifica-

3. From the Latin, meaning "a drop."

4. The Bayer Company took the willow bark treatment one step further in 1897, manufacturing acetylsalicylic acid, better known as aspirin.

5. Used as a bone screw.

tion, when Sir Alfred Garrod, a London physician, coined the clinical term *rheumatoid arthritis* (Underwood 2000). Rheumatoid arthritis is an inflammatory disease that causes pain, swelling, stiffness, and loss of function in the joints. It has several special features that make it different from other kinds of arthritis. For example, rheumatoid arthritis generally occurs in a symmetrical pattern. This means that if one knee or hand is afflicted, the other is also. The disease often affects the wrist joints and the finger joints closest to the hand, but can also affect other parts of the body. Some remissions do occur, but the illness progresses to produce permanent damage and deformity. Rheumatoid arthritis occurs in all races and ethnic groups. It often begins in middle age and occurs with increased frequency in older people (NIAMS 1998).

Osteoarthritis[6] was commonly used as a synonym for rheumatoid arthritis beginning in the 1860s. A clear distinction between the two ailments began to emerge at the turn of the century with the development of x-rays. In 1904, Boston physician Joel E. Goldthwait described differences revealed by x-rays. Osteoarthritis is a joint disease that mostly affects the cartilage, which is the slippery tissue that covers the ends of bones in a joint. With this disease, the surface layer of the cartilage breaks down and wears away. This allows bones under the cartilage to rub together, causing pain, swelling, and loss of motion of the joint. Today, osteoarthritis is the most common type of arthritis, especially among older people, and one of the most frequent causes of disability among adults (NIAMS 2002).

Migratory arthritis refers to pain and swelling in a specific joint that has a fairly rapid onset, disappears in the course of twenty-four or thirty-six hours, and then is followed by similar symptoms elsewhere that are usually asymmetric (Barth 1997).

2.2.1 The Diagnosis of Arthritis

Arthritis is very difficult to diagnose in its early stages, for several reasons. First, there is no single test for the disease. Second, symptoms differ from person to person and can be more severe in some people than in others. Third, the full range of symptoms develops over time, and only a few symptoms may be present in the early stages. As a result, doctors use a variety of tools to diagnose the disease and to rule out other conditions. These tools include the medical history (the patient's description of symptoms and when and how they began), physical examination, laboratory tests, and x-rays.

The method used to diagnose arthritis has not changed much in history.[7] The appearance of x-rays and the development of laboratory tests such as

6. From the Greek *osteon*, meaning "bone."

7. Since the method of diagnosing arthritis has not changed much over time, comparing prevalence rates for this disease at different points in time seems plausible.

blood tests have only helped to make a distinction between different kinds of arthritis. The most important tool for the diagnosis of arthritis, however, has always been the medical history.

The history probably provides 80 percent of the necessary information, whereas the physical examination provides 15 percent, and laboratory tests and x-rays, 5 percent. Moreover, the history influences many of the decisions to order laboratory tests and x-rays. The type of symptom onset is highly informative. The history may also reveal the presence of morning stiffness, a common symptom in many patients with rheumatic complaints. The duration and extent of morning stiffness are helpful guides to the degree of inflammation that may be involved. For example, in cases of rheumatoid arthritis, morning stiffness typically extends for several hours, affects the whole body, and is associated with afternoon fatigue. In cases of noninflammatory joint problems such as osteoarthritis, morning stiffness may be brief and is usually limited to the affected joint (Barth 1997).

In a physical examination, helpful points of differentiation include the number of joints involved, their location, and, when multiple joints are involved, whether they are symmetric or asymmetric. The duration of symptoms and changes over time are important considerations. Age and gender should be noted in the office evaluation because they can provide clues to rheumatic diseases seen more frequently in one age or gender group than another.

Classic signs and symptoms that can be readily diagnosed by the primary care physician accompany many musculoskeletal complaints. Others are much less obvious: in the office evaluation of patients with musculoskeletal complaints, the least helpful elements are laboratory tests. Although available tests are sensitive to the presence of rheumatic diseases, they are not specific for any of them. Thus, the most commonly used laboratory tests for rheumatic diseases should be considered helpful but not diagnostic. They must be ordered and interpreted in the context of the history and the physical examination findings (Barth 1997).

X-rays for a new joint complaint are helpful only in certain situations. They show bone best, but they are less helpful in showing changes in soft tissue. It may take a long time for some symptoms to cause erosion visible by conventional radiography.

Scientists do not yet know what causes the disease, but they suspect a combination of factors, including being overweight, aging, joint injury, stresses on the joints from certain jobs and sport activities, and environmental factors. Also, scientists have found that certain genes that play a role in the immune system are associated with a tendency to develop certain kinds of arthritis. Thus, an infection followed by an altered or sustained immunologic response could be instrumental for development of the disease (NIAMS 1998, 2002).

Patients with infectious arthritis frequently have underlying conditions

such as neoplasia, liver disease, and chronic renal failure. Migratory arthritis is most common in patients with viral diseases, acute rheumatic fever, and bacterial endocarditis. Other symptoms of arthritis could be psoriasis, Reiter's syndrome, and inflammatory bowel disease. These conditions can cause inflammation of the joints. Another related disease is gout. Arthritis patients are often diagnosed as also having gout (Barth 1997).

2.3 Data

We have used three different samples to explore the evolution of the prevalence for arthritis among the U.S. population from the late nineteenth century to today.

To calculate prevalence rates during the late nineteenth century and the beginning of the twentieth century, we have used the data in the Surgeon's Certificates. This dataset contains 87,223 medical exam records from 1862 to 1940 for 17,721 Union Army pensioners with a documented birthdate (Fogel 2000, 2001). Each Civil War veteran received a thorough medical examination when he originally applied for a pension and every time he asked for an increase in the pension amount. These examinations were performed by a board of physicians appointed by the Bureau of Pensions. The physicians would assess the veteran's general health (as well as diagnose any specific impairment) and record the symptoms. The majority of these exams occurred between 1885 and 1920 (Linares 2001).

The conditions in this dataset are classified by disability groups. Those groups include cardiovascular, ear, eye, gastrointestinal, genito-urinary, respiratory, musculoskeletal, and liver/spleen/gallbladder conditions, as well as infectious diseases and fevers, injuries, neoplasms/tumors, nervous disorders, disorders of the rectum/hemorrhoids, varicose veins, hernias, and general appearance (conditions involving mainly blood, nutrition, and skin, gum, teeth, and muscles). Specifically, the musculoskeletal group is defined by any one of the following conditions: rheumatism, sciatica, and spinal curvature. In this study we examine the rheumatism variable among these three conditions, since it generally describes arthritis cases by specifying the part of the body in which inflammation of the joint or muscle was detected.[8]

To compare the Union Army prevalence rates with recent ones, we use the National Health and Nutrition Examination Survey (NHANES) conducted by the National Center of Health Statistics (NCHS). This survey includes data on the health status of U.S. residents as well as a number of demographic and socioeconomic variables. There are four phases of the

8. The sciatica variable is identified when the claimant had pain or tenderness of the sciatic nerve. The spinal curvature variable conveys information about the location of kyphosys, scoliosis, or lordosis.

NHANES that have been released so far: NHANES I was conducted from 1971 to 1975, NHANES II from 1976 to 1980, NHANES III from 1988 to 1994, and NHANES IV from 1999 to 2000.

Finally, the other data source used to calculate current prevalence rates comes from the National Health Interview Survey (NHIS). The NHIS is a multipurpose health survey also conducted by the NCHS and is the principal source of information on the health of the civilian, noninstitutionalized household population of the United States. The NHIS has been conducted annually since its beginning in 1957 and public use data is released on an annual basis. The NHIS questionnaire items are revised every ten to fifteen years, with the last major revisions having occurred in 1982 and in 1997.

In these two surveys one of the health conditions the individuals are asked about is arthritis. However, except in the last two NHANES, the type of arthritis is not specified.

Although the NHIS has been conducted since 1957, suitable data on arthritis are available only since 1990. The variables referring to the health status of the population in the NHIS are self-reported. By contrast, in the NHANES the questions referring to health conditions specifically ask, "Has a doctor ever told you that you have . . . ?"

Another disadvantage of using the NHIS to study changes in prevalence rates over time is the fact that the questionnaire has changed significantly over the years. Specifically, the 1997 revision has changed the question from "did you ever have arthritis?" to "does arthritis cause any limitation?" Because of this, we only use the available years for the NHIS prior to 1997.

Since the Surgeon's Certificates contain information only for Civil War Union Army veterans, we limit the calculations in the NHANES and the NHIS to adult white males in order to compare results across the different data sets.

Also, to make the NHANES and the NHIS samples representative of the adult white male U.S. population, we use weighted data.

2.4 Prevalence Rates and Duration of Arthritis

By calculating prevalence rates for white males with arthritis for the Union Army sample, as well as for the NHANES and NHIS samples, we try to analyze how the life cycle pattern of this specific disease has changed over time.

For each individual observation that reports an arthritic condition in any of the datasets used, a dummy variable coded 1 was created. If no arthritis is found, the arthritis dummy variable was coded 0. The arthritis prevalence rate is defined as the number of individuals with arthritis divided by the total number of individuals at risk in a given group.

First, in figure 2.1, we graph the prevalence rates for birth cohorts over the years between 1873 and 1910. Then, in figure 2.2, we graph the

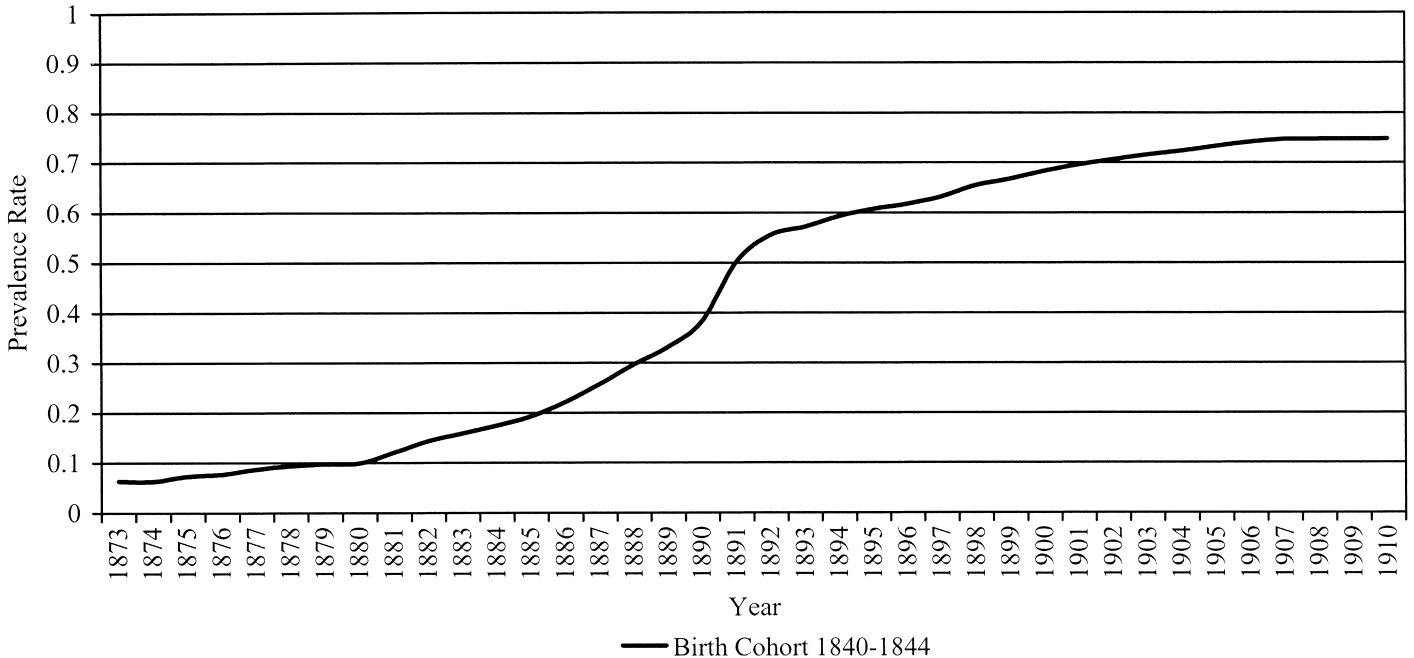

Fig. 2.1 **Arthritis prevalence rate among Union Army veterans by selected birth cohorts, 1873–1910**

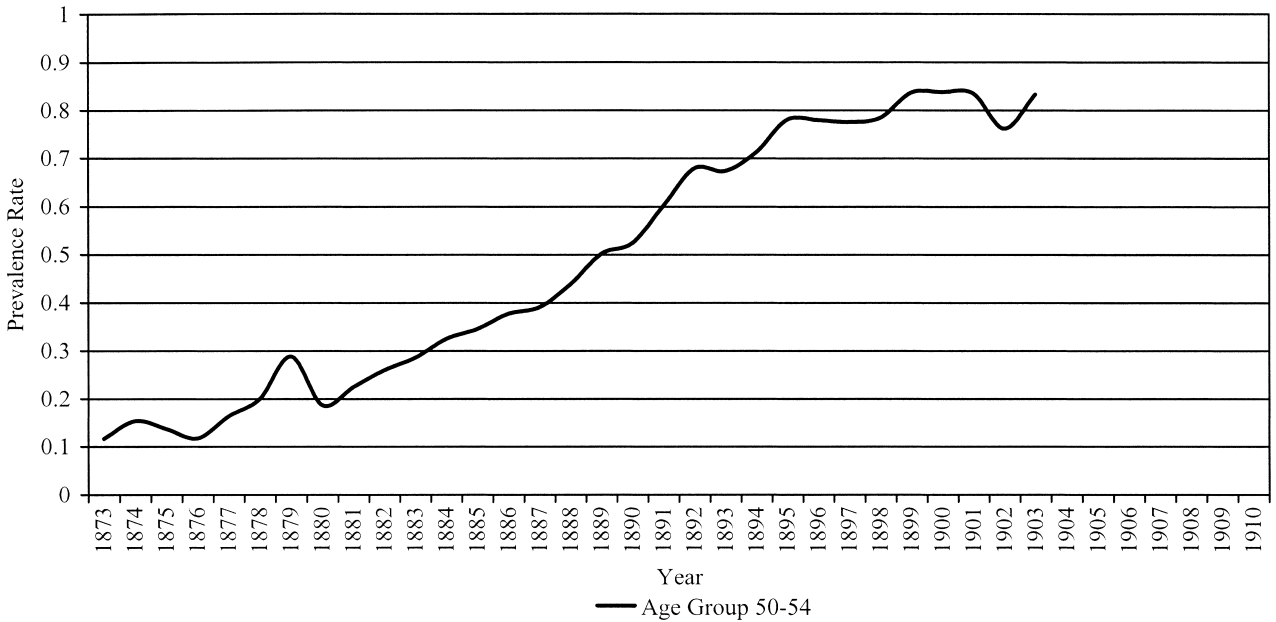

Fig. 2.2 Arthritis prevalence rate among Union Army veterans by selected age groups, 1873–1910

prevalence rates for veterans of a given age at each year between 1873 and 1910.[9] This second way of looking at prevalence rates helps to assess the impact of changes in pension law and practices on the calculated rates.

Figure 2.1 shows that the rate of increase in prevalence rates was greater before 1892 than after that year. For example, the cohort born between 1840 and 1844 had a prevalence rate below 10 percent in 1875, when it was between ages thirty-one and thirty-five. A decade later, its prevalence rate was double, and in 1890 was 40 percent. Finally, when the cohort was aged sixty-one to sixty-five, its prevalence rate was over 70 percent. In other words, the prevalence rate of this cohort increased more rapidly before 1892 than afterward. Note particularly the sharp acceleration in the prevalence rates between 1890 and 1892. This acceleration is very likely due to the law of 1890, which removed the restriction that a veteran was eligible for a pension only if his arthritis was war related. Under the law of 1890, having arthritis, regardless of its cause, was sufficient to warrant admission to the pension system.

The suspicion that administrative decisions influenced the prevalence rates is confirmed by figure 2.2. Here, the line shows the prevalence rate of veterans between fifty and fifty-four years old for each year between 1873 and 1903, after which the line ends because all veterans were over age fifty-four by then. Notice that in 1875 the prevalence rates among these veterans was less than 15 percent, but in 1895 the prevalence rate was over 70 percent. Since public health in the cities deteriorated badly between 1830 and 1860, one would expect the increased insults at developmental ages to be reflected in higher prevalence rates at middle ages, but one would hardly expect a ten-fold increase. Most of the increase in the prevalence rates of veterans between fifty and fifty-four years old reflects changes in pension policy.

How, then, should figure 2.1 be interpreted? Prevalence rates are too low before 1890. They are biased downward most sharply before 1880, after which the pension officials became more liberal in interpreting whether arthritis was war related. Hence the acceleration in the arthritis rates between 1881 and 1890 is exaggerated. The further acceleration between 1890 and 1892 reflects the impact of the 1890 law. After 1892, the prevalence rates appear to be unbiased by administrative decisions. Notice also that the difference in prevalence rates by birth cohort in any given year remain consistent and do not appear to have been affected by administrative directives. At late ages, all of the cohorts show prevalence rates of arthritis between 70 and 80 percent. These extremely high prevalence rates at the end of the nineteenth century suggest poor environmental, socioeconomic, and health conditions during this period.

9. We choose to graph only one birth cohort and only one age group, since the behavior of all of them is very similar. The birth cohort and the age group chosen are the largest.

To clarify this interpretation, we calculate the prevalence rates by age group and birth cohort for the NHANES survey. Table 2.1 shows the prevalence rate by age group, as well as the average duration of arthritis in years, for each of the first three phases of the NHANES survey,[10] as well as for these phases aggregated together. Here, the prevalence rate is generally decreasing over time for the same age group. For example, for individuals aged between sixty and sixty-four the prevalence for the period 1971–1975 is greater (35 percent) than the prevalence for the period 1988–1994 (29 percent). Table 2.1 shows that between 1971–1975 and 1988–1994, prevalence rates continued to fall at most ages. The maximum prevalence rate is 41 percent at ages seventy-five to seventy-nine in NHANES III, which is almost half the rate in the Union Army sample at the same age. Thus, over the past century, prevalence rates of arthritis have decreased by about half.

We calculate the prevalence rate by cohort for each five-year age interval when the three reported phases of the NHANES are aggregated together. Figure 2.3 shows the line that represents the evolution of arthritis prevalence for the cohort born before 1920. The lines representing other cohorts are not shown, since most recent cohorts are not numerous enough to graph. Although the prevalence rate increases with age, the rise is modest compared with the Union Army cohort.

The peak at age eighty in figure 2.3 is 41 percent, which again is almost half that for the Union Army cohort.

Table 2.2 shows the prevalence rates for different stages of the NHIS survey as well as for all these stages aggregated. Even when the prevalence rate increases with age, the level of the prevalence rates in this case is lower than for the NHANES. Self-reporting seems to undercount the prevalence of arthritis. It might be that with over-the-counter painkillers widely available, people do not feel as if they have arthritis. This undercounting is present across all age groups. Consequently, the NHANES is a more appropriate dataset to work with.

The results suggest that aging was and continues to be a very important factor in the prevalence of arthritis in an individual's life. However, when observing the life cycle evolution, the pronounced increase in the prevalence of arthritis with age during the late nineteenth century moderated during the twentieth century, as reflected in the NHANES and NHIS data.

A more interesting question that is possible to analyze only with the Union Army data is the average number of years a person lives after first being diagnosed with the disease. Table 2.3 shows the average number of years lived with arthritis by age groups for the Union Army veterans. For people diagnosed with the disease at earlier ages, its duration was greater

10. The data released for NHANES IV contain very few observations, and thus we obtained no reliable results to compare with the prevalence rates for the other phases of the NHANES.

Table 2.1 **Arthritis prevalence rate and average duration in years among U.S. white males, 1971–1994**

	NHANES I (1971–1975)		NHANES II (1976–1980)		NHANES III (1988–1994)		Total NHANES (1971–1994)	
Age group	Prevalence rate	Average duration	Prevalence rate	Average duration	Prevalence rate	Average duration	Prevalence rate	Average duration
Less than 50	0.054	6.974	0.048	7.256	0.070	8.573	0.052	7.489
50 to 54	0.261	9.424	0.195	10.026	0.181	9.924	0.211	9.393
55 to 59	0.280	11.558	0.300	12.065	0.167	11.860	0.263	11.649
60 to 64	0.352	11.816	0.333	11.253	0.290	11.167	0.323	11.248
65 to 69	0.354	13.137	0.345	13.030	0.332	12.163	0.352	12.943
70 to 74	0.382	13.519	0.360	15.695	0.368	14.236	0.375	14.172
75 to 79					0.411	14.509	0.411	14.509
80 to 84					0.399	15.913	0.399	15.913
85 to 89					0.363	14.535	0.363	14.535
Total number of persons	6,336		7,466		6,439		20,241	
Total number of persons w/ Arthritis	1,094		1,228		1,165		3,487	

Source: Authors' calculations from NHANES I, NHANES II, and NHANES III.

Note: White males are divided into five-year age groups according to their age at the time of the survey.

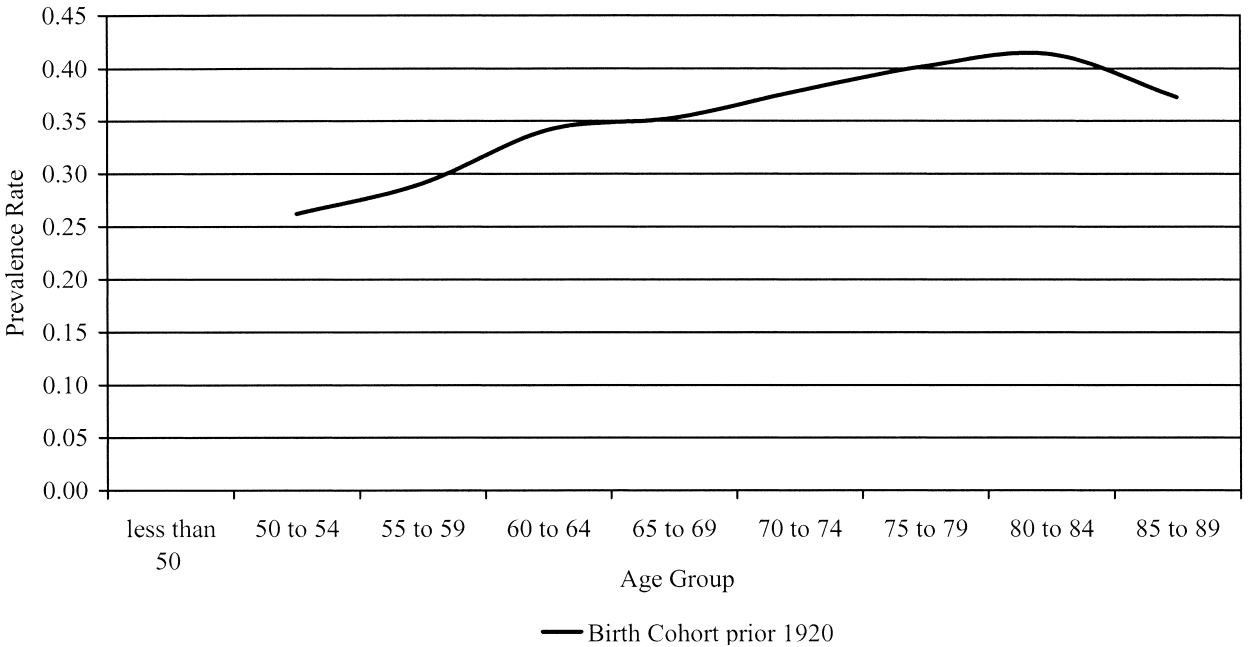

Fig. 2.3 Arthritis prevalence rate among U.S. white males by selected birth cohorts, 1971–1994

Table 2.2 **Arthritis prevalence rate among U.S. white males, 1990–1994**

Age group	1990 NHIS Prevalence rate	1991 NHIS Prevalence rate	1992 NHIS Prevalence rate	1993 NHIS Prevalence rate	1994 NHIS Prevalence rate	1990–1994 (Total NHIS) Prevalence rate
Less than 50	0.043	0.046	0.044	0.048	0.043	0.045
50 to 54	0.091	0.119	0.101	0.092	0.108	0.103
55 to 59	0.118	0.157	0.137	0.153	0.144	0.141
60 to 64	0.183	0.174	0.184	0.176	0.145	0.171
65 to 69	0.177	0.194	0.189	0.197	0.202	0.191
70 to 74	0.191	0.189	0.198	0.189	0.224	0.196
75 to 79	0.195	0.229	0.209	0.209	0.209	0.214
80 to 84	0.198	0.258	0.209	0.240	0.234	0.231
85 to 89	0.166	0.282	0.224	0.231	0.163	0.203
90 to 94	0.208	0.209	0.153	0.195	0.235	0.212
95 to 99	0.169	0.346	0.393	0.388	0.000	0.222
Total number of persons	15,626	14,481	15,691	13,675	14,233	73,706
Total number of persons w/ Arthritis	1,559	1,579	1,631	1,461	1,477	7,707

Source: Authors' calculations from NHIS.

Note: White males are divided into five-year age groups according to their age at the time of the survey.

Table 2.3 **Years lived with arthritis among Union Army veterans**

	Years lived with Arthritis after first diagnosis				
Age group	N	Mean	Std. dev.	Minimum	Maximum
Less than 50	4,088	24.320	10.561	1.000	58.000
50 to 54	2,644	19.531	9.028	1.000	42.000
55 to 59	2,044	16.410	8.356	1.000	39.000
60 to 64	1,484	13.501	7.592	1.000	37.000
65 to 69	711	11.274	6.766	1.000	30.000
70 to 74	243	9.531	6.461	1.000	27.000
75 to 79	59	6.305	4.477	1.000	20.000
80 to 84	16	5.313	5.606	1.000	20.000
85 to 89	5	4.600	3.578	1.000	9.000

Source: Authors' calculations from Surgeon's Certificates.

Note: Recruits are divided into five-year age groups according to their age at the first diagnosis of arthritis.

than if the diagnosis occurred later in life. For example, people diagnosed with arthritis when they were between fifty and fifty-four years lived with the disease for another twenty years, while people first diagnosed when they were seventy to seventy-four years old had arthritis for almost ten years. It follows that people who got arthritis later in life had a longer lifespan than those who developed it earlier.[11]

In order to obtain a more reliable evaluation of the effect of arthritis on longevity, it is necessary to run a set of regressions analyzing the impact of various diseases and socioeconomic factors.

Table 2.1 has data on the duration of the disease for the NHANES survey.[12] Here, the average duration is defined as the number of years a person had lived with arthritis at the time of the interview. However, this duration is defined differently from the one reported for the Union Army in table 2.3.

Table 2.1 shows that duration increases with age. But increase in duration is less than the increase in age. For example, for NHANES I, people aged sixty to sixty-four had had arthritis for almost twelve years on average when interviewed, and people aged sixty-five to sixty-nine had had arthritis an average of approximately thirteen years. Thus, people aged sixty-five to sixty-nine had had arthritis only one more year than people aged sixty to sixty-four, despite the fact that they were five years older. This means that an increasing number of people get arthritis later in life. This is another fact that suggests that the age-specific and the birth-cohort longitudinal increase in prevalence rates of arthritis is less in the NHANES than in the Union Army.

Table 2.4 shows the average number of years Union Army veterans had

11. We consider arthritis a chronic condition, so once diagnosed, the disease will be present all the remaining years of life.

12. In the NHIS no similar data is available on the duration of arthritis.

Table 2.4 **Duration of arthritis by age among Union Army veterans, 1895**

	Duration of arthritis in years				
Age group	N	Mean	Std. dev.	Minimum	Maximum
Less than 50	4,088	5.599	3.782	1.000	32.000
50 to 54	17,312	6.512	5.077	1.000	32.000
55 to 59	12,719	7.128	5.095	1.000	32.000
60 to 64	7,349	7.438	5.150	1.000	32.000
65 to 69	4,672	8.332	5.661	1.000	32.000
70 to 74	2,423	9.304	6.288	1.000	32.000
75 to 79	1,360	11.835	7.515	1.000	32.000
80 to 84	87	11.667	5.724	3.000	26.000
85 to 89	24	11.250	6.771	4.000	24.000

Source: Authors' calculations from Surgeon's Certificates.

lived with arthritis in 1895. Even though this is a lower-bound estimate of the duration of arthritis in the Union Army (because it is possible that veterans had the disease even before applying for a pension), this table is comparable with table 2.1. Duration of the condition increases with age, but it is lower than in the NHANES sample for all age groups.

2.5 What Affects the Probability of Having Arthritis?

We have demonstrated that the current prevalence rate of arthritis is lower than in the late nineteenth century and beginning of the twentieth century. The question to be answered now is what is the possibility that prevalence rates will continue to decline.

To assess whether this trend is continuing, we run some logistic regressions trying to identify the factors influencing the odds of having arthritis. To do so, we estimate the effect of different health and socioeconomic variables on the probability of being diagnosed with arthritis, using the data from the Union Army records described before.

First, we construct as a dependent variable a dummy that takes the value 1 if the veteran had arthritis at some point in his life and 0 if he never had been diagnosed with the disease.

As independent variables we include the number of disabilities the veteran had during his life, the age at the first physical exam for the pension application process, the BMI at that exam,[13] the number of battles the veteran participated in, and the number of years enlisted in the army. We also include some socioeconomic factors that could be related to this disease. Some of these factors affecting the probability of having arthritis could be

13. We group the BMIs in four categories: underweight (BMI less or equal to twenty), normal (between twenty and twenty-five), overweight (between twenty-five and thirty) and obese (more than thirty).

the number of inhabitants in the place where the individual lives, marital status, level of income, and occupation.

We construct dummy variables for veterans' residence and birth places. We group the United States into four regions: Northeast, Midwest, West, and South.[14] Using these regions, we create a set of five dummies for being resident at enlistment in any of them or outside these regions, either unspecified or outside the United States. We also classify the place of birth, using six dummies indicating whether the veteran had been born in one of the four regions of the United States, in an unspecified place, or outside the United States (i.e., this indicates whether the veteran was an immigrant).

We create a set of dummies reflecting the veteran's occupation at enlistment by dividing the different occupations into five categories: farmers, professionals, artisans, manual laborers, and all other occupations. Also, another variable included is a dummy taking the value 1 if the veteran was ever married, and zero otherwise.

For data from the 1900 census, we construct a similar set of dummies reflecting the veteran's place of residence and occupation in 1900 as well as two dummy variables to capture any change in place of residence or occupation since time of enlistment. However, none of these variables had a significant effect when included in the regression analysis.

A weakness of this dataset is that it contains no information on education and scarce information on personal wealth. Even when some data describing wealth is included in the estimation, the number of observations is too small and thus not statistically significant.

Table 2.5 shows the summary statistics of the variables included in the logistic regression. The results of the logistic regression are shown in table 2.6.

These results suggest that older people had a greater probability of having arthritis; age increased the probability of getting the disease at a decreasing rate. This is corroborated by the positive coefficient on the total number of disabilities over life. A person with a greater number of disabilities generally was older and the probability of having arthritis increased.

Those veterans who were enlisted for a longer period of time had a lower probability of getting arthritis. Those men who were in the army for a longer period were probably healthier, since those who were sick would have had to leave the army. Those that resided in the Northeast, were manual laborers, or had higher BMIs had a greater probability of developing the disease. This suggests that residing in more populated places could

14. These are the regions used by the Bureau of the Census. The Northeast comprises: Connecticut, Massachusetts, Vermont, New Hampshire, Rhode Island, Maine, New Jersey, New York, and Pennsylvania. The Midwest comprises: North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Michigan, and Ohio. The South comprises: Oklahoma, Texas, Arkansas, Louisiana, Mississippi, Alabama, Tennessee, Kentucky, Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia, District of Columbia, Maryland, and Delaware. The West comprises: Washington, Oregon, California, Arizona, Nevada, Idaho, Montana, Wyoming, Utah, Colorado, New Mexico, Hawaii, and Alaska.

Table 2.5 Descriptive summary statistics, Union Army veterans

Variable	N	Mean	Std. dev.	Minimum	Maximum
Dummy = 1 if ever had arthritis	17,702	0.518	0.500	0.000	1.000
Age at first exam	16,586	47.322	10.462	16.000	85.000
Total number of conditions diagnosed over life	16,574	7.055	3.538	0.000	19.000
Number of years enlisted	15,945	2.477	0.901	0.083	9.000
Dummy = 1 if BMI at first exam					
Less than 20	14,697	0.120	0.325	0.000	1.000
20–25	14,697	0.642	0.479	0.000	1.000
26–30	14,697	0.198	0.398	0.000	1.000
More than 30	14,697	0.041	0.198	0.000	1.000
Dummy = 1 if place of residence at enlistment					
Northeast	17,339	0.295	0.456	0.000	1.000
Midwest	17,339	0.568	0.495	0.000	1.000
South	17,339	0.084	0.277	0.000	1.000
West	17,339	0.047	0.212	0.000	1.000
Not in U.S. or unspecified	17,339	0.006	0.078	0.000	1.000
Dummy = 1 if occupation at enlistment					
Farmer	17,476	0.562	0.496	0.000	1.000
Professional	17,476	0.065	0.247	0.000	1.000
Artisan	17,476	0.191	0.393	0.000	1.000
Manual laborer	17,476	0.130	0.337	0.000	1.000
Other	17,476	0.051	0.220	0.000	1.000

Source: Authors' calculations from Surgeon's Certificates and Union Army records.

have a positive effect on the odds of contracting this disease. Those veterans who were residents of less populated areas had a lower expected chance of getting the disease than those living in densely populated areas. At that time, rapid urbanization, especially in the Northeast, made cities a less healthy environment due to overcrowding, the absence of sewage systems, no water filtration, and other poor sanitary conditions. However, since the coefficient for those residing in the South is also positive and significant, we may be in the presence of a weather effect at the same time. Even though the relationship between weather and arthritis is still not proved, it is well known that under some weather conditions the pain is more severe.

Nutrition, as predicted by the theory of technophysio evolution, seems to have had a large impact on the odds of the disease during the post-Civil War period. Those with higher BMIs had a greater risk of getting arthritis, since the excess weight could affect the joints.

The fact that those veterans in nonfarming occupations had a greater probability of being diagnosed with arthritis suggests that the physical characteristics needed to perform certain jobs had a significant effect on this disease.

The logistic analysis shows that aging has a very important effect on this disease.

Table 2.6 Logit model, Union Army veterans

Constant	–5.118
	(0.433)***
Total number of conditions diagnosed over life	0.119
	(0.005)***
Age at first exam	0.153
	(0.017)***
Age at first exam square	–0.001
	(0.0002)***
Number of years enlisted	–0.130
	(0.02)***
Dummy = 1 if place of residence at enlistment	
Northeast	0.237
	(0.043)***
Midwest	omitted
South	0.237
	(0.067)***
West	–0.138
	(0.084)*
Not in U.S. or unspecified	0.257
	(0.216)
Dummy = 1 if occupation at enlistment	
Farmer	omitted
Professional	–0.051
	(0.078)
Artisan	0.027
	(0.050)
Manual laborer	0.091
	(0.057)*
Other	0.186
	(0.088)**
Dummy = 1 if BMI at first exam	
Less than 20	–0.405
	(0.057)***
20–25	omitted
26–30	0.263
	(0.047)***
More than 30	0.307
	(0.093)***
Observations	13,485
Pseudo R^2	0.055

Notes: The dependent variable is a dummy indicating whether the veteran ever had arthritis. Between brackets the standard error for each coefficient is shown. Information comes from surgeon's certificates and Union Army records.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

At the beginning of the twentieth century, residing in a less healthy environment, such as the overpopulated cities of that time, had a greater impact on the diagnosis of arthritis. So it is very likely that the decline of the prevalence rates over time is related to the improvements in sanitary conditions. Also, improvements in occupational conditions could have been in part responsible for the decline of arthritis prevalence rates. Finally, it seems that obesity and malnutrinition are two problems that cannot be ignored when trying to reduce the prevalence rate of this particular disease.

2.6 Conclusions

Disability caused by arthritis has decreased over time when extending the time horizon further than the beginning of twentieth century. One possible explanation is based on the progress of medicine during the century. This has brought many new forms of treatment for arthritis that have affected the severity of this condition since the late nineteenth century.

Moreover, contemporary prevalence rates are lower than in the late nineteenth century, reflecting changes in public health, lifestyle, and the distribution of occupations.

The tremendous change in public health infrastructure (improvements in the water supply, better sewage systems, cleaning of the milk supply) has reduced the probability of developing arthritis at later ages by reducing insults during earlier years of life. Also, for those people who have it, arthritis is less severe now, partly because of many interventions that were not available in the late nineteenth century. Finally, the accomplishment's of modern medicine has led to the alleviation of the severity of the condition, both through drugs and by advocating changes in lifestyle.

The aging process is critical for this condition, and is one of the main reasons that older people suffer more from this disease. Over the life cycle of each individual, arthritis prevalence is increasing at any point in time.

The results obtained confirm the fact that, historically, older men had a worse health status than they have today.[15] Age-specific prevalence rates are declining, and the average age of onset is eleven years later; moreover, the contemporary proportion of males who ever get arthritis is substantially lower than the historical record.

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